

How to rectify scanned air photos using ERDAS Imagine AutoSync (in the real world)

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Problem: road is being attacked by streams

Yellowstone National Park
Wyoming - Montana - Idaho

2009 NAIP - Lamar R. - Soda Butte Ck. Confluence

National Park Service
U.S. Department of the Interior



Produced by the Yellowstone Spatial Analysis Center 307-344-2245

Map Produced February 2011

FILE: C:\Scratch\lamar_imagery\imagery_inspection.mxd

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Or is it?

(cue ominous music)

0 0.1 0.2 0.4 0.6 0.8 1 Kilometers

0 0.1 0.2 0.4 0.6 0.8 1 Miles



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Map Produced February 2011

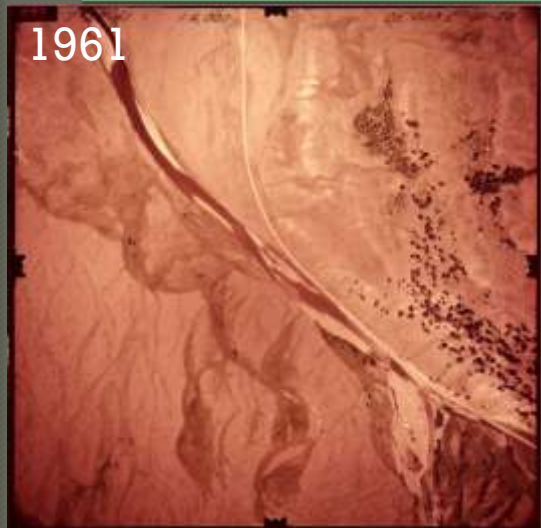
FILE: C:\Scratch\lamar imagery\imagery_inspection.mxd

What imagery do we have?

- ◉ 2009 NAIP
- ◉ 2006 NAIP
- ◉ 2006 QuickBird
- ◉ 2002 CIR DOQQ
- ◉ 1996 Grayscale DOQQ
- ◉ And...

...a lot of paper photos

1961



1971



1976



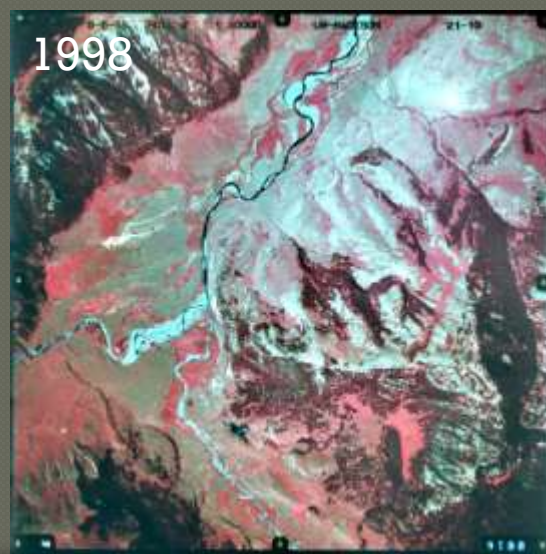
1982



1988



1998



So here's the plan:

- ◉ Scan air photos
- ◉ **Rectify them** ←
- ◉ Extract stream courses
- ◉ See how the stream changed over time

Options for rectification?

- ◉ No camera reports for most
- ◉ Multiple scales
- ◉ Not a lot of time
- ◉ Have an AutoSync license, why not use it?

AutoSync looks so easy

- But it really isn't
- This process, like so much of image processing is a bit of science and a lot of art.
- The ERDAS documentation for this module will help you understand the process - I would suggest scanning over the following - C:\ERDAS\ERDAS Desktop 2010\help\hardcopy\AutoSync.pdf

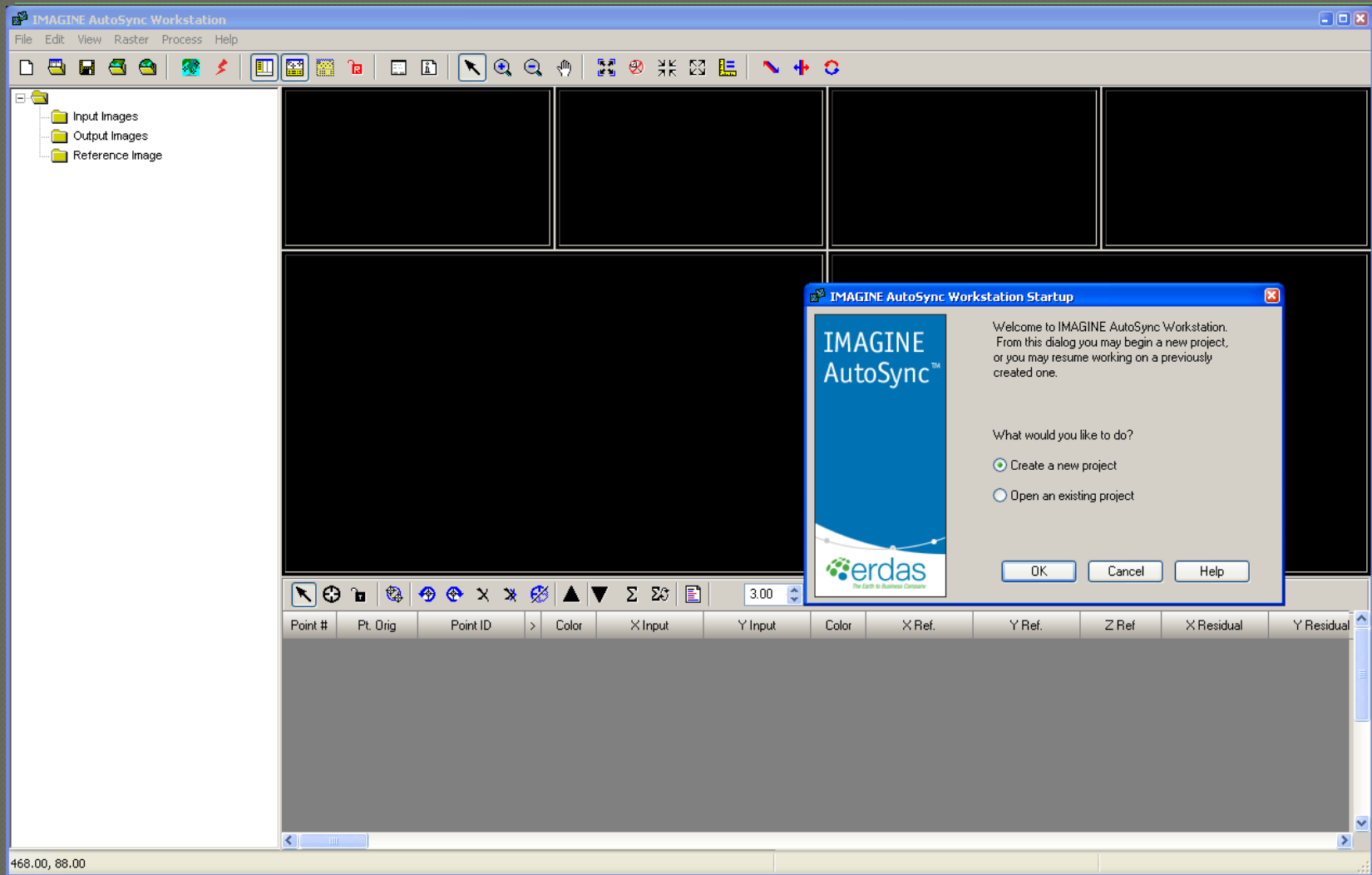
General Process Steps:

1. Prep your reference image (if needed)
2. Create an AutoSync project
3. Add your input and reference images
4. Add manual control points
5. Verify and/or adjust your project parameters
6. Solve model
7. Run automatic point matching (APM)
8. Verify and/or delete control points
9. Re-solve model
10. Export Image

1. Prep your reference image

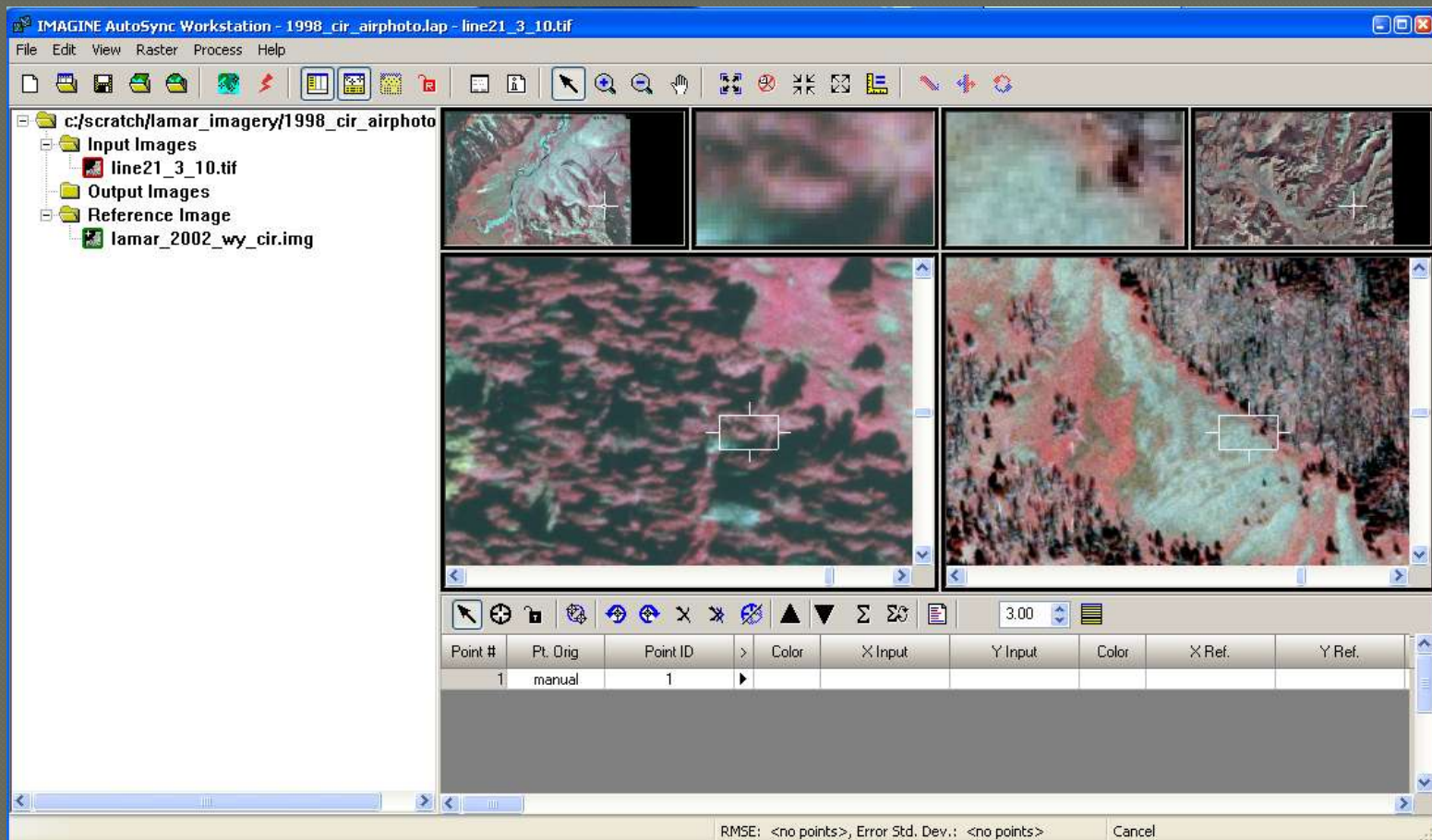
- You must choose your image wisely
- Ideally this image will be larger than the airphoto(s) you are trying to correct and have similar characteristics.
- For instance, if you are attempting to rectify a color infrared air photo of the Seattle area from 1982, you should find a color infrared reference image (or an image with similar bands) that covers the entire Seattle area. Ideally the spectral signature would be similar - if it's a wet year /month you are trying to rectify, pick a reference image taken in a wet year/month.
- You may need to clip out a section of your reference imagery, or mosaic quarter quads together to cover your area of interest. You only get one reference image per project!

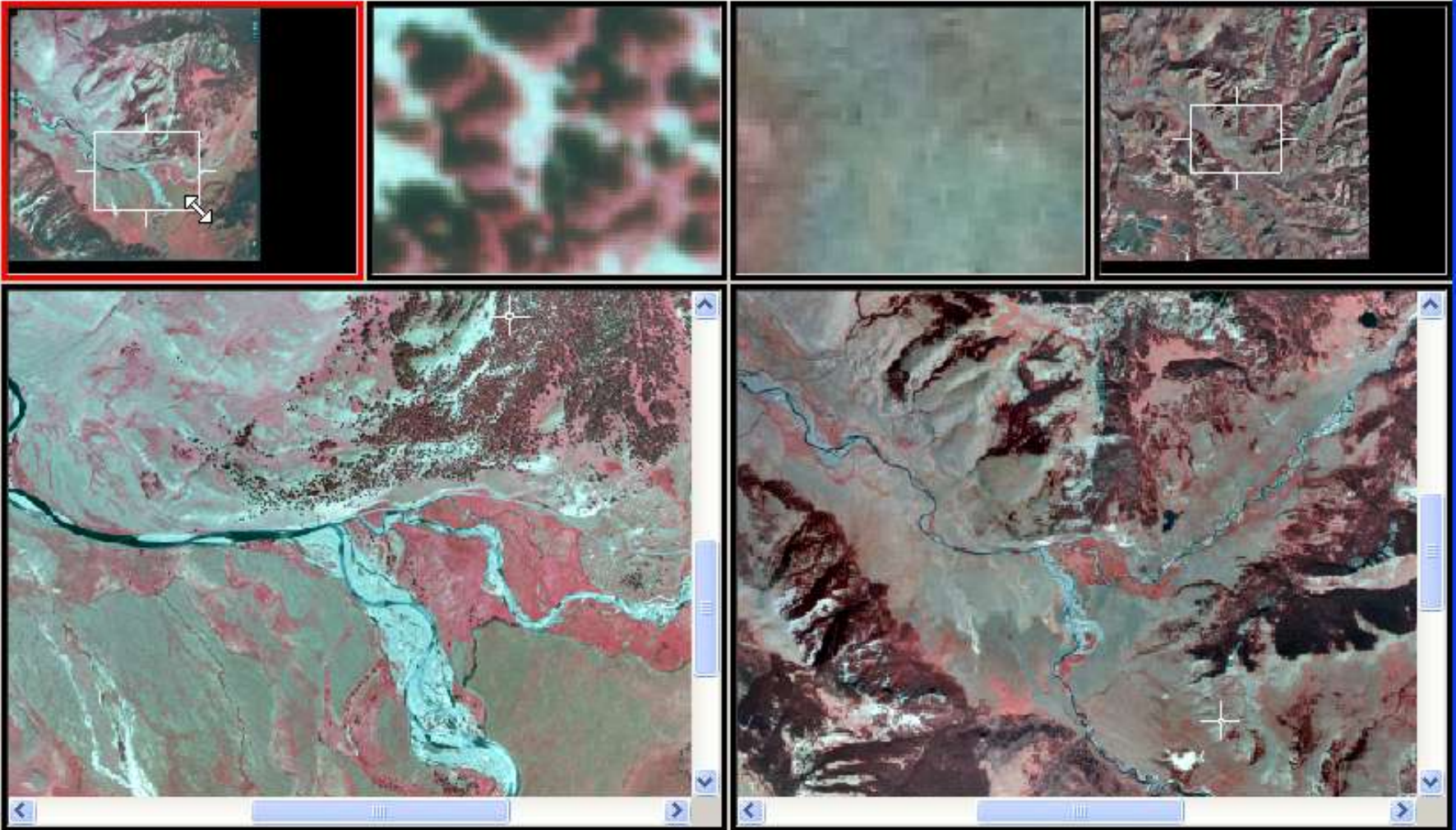
2. Create an AutoSync project



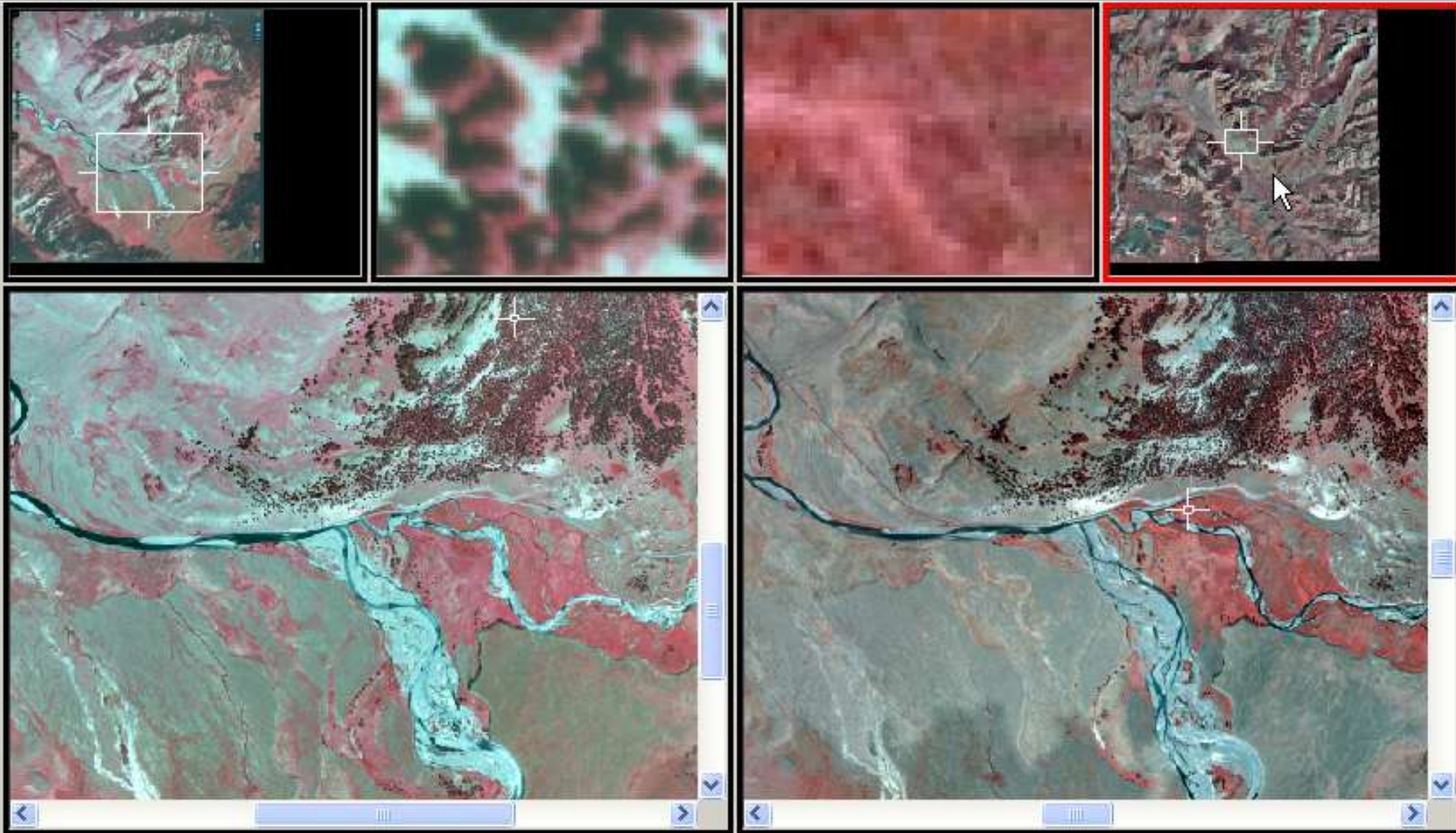
3. Add your input and reference images

- Your input image is the one you want to rectify, the reference image is the one you want to use as your reference.





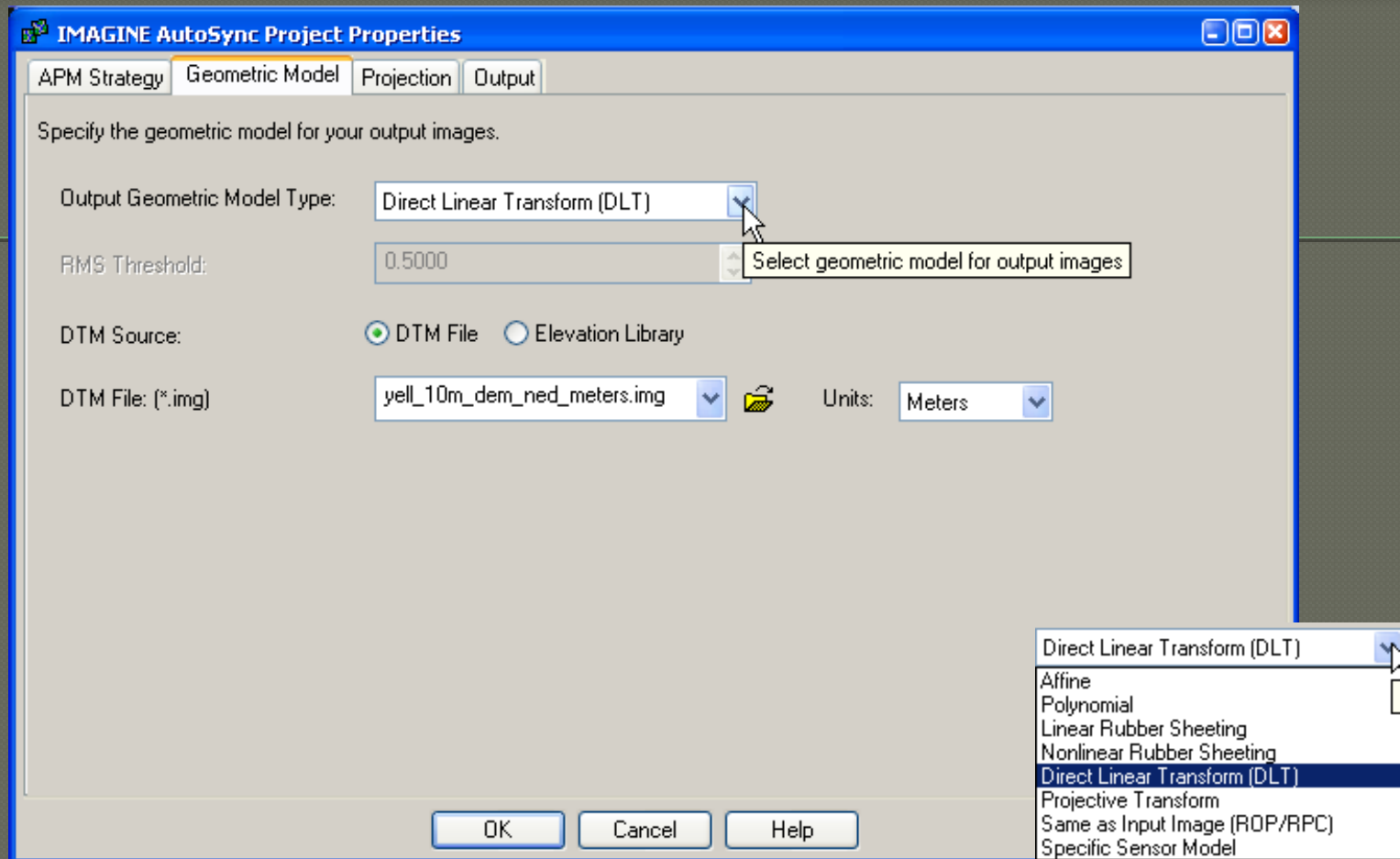
- In the image above, the upper outside panes have roughly the same size boxes, but different coverage. I will make the right box smaller to compensate:



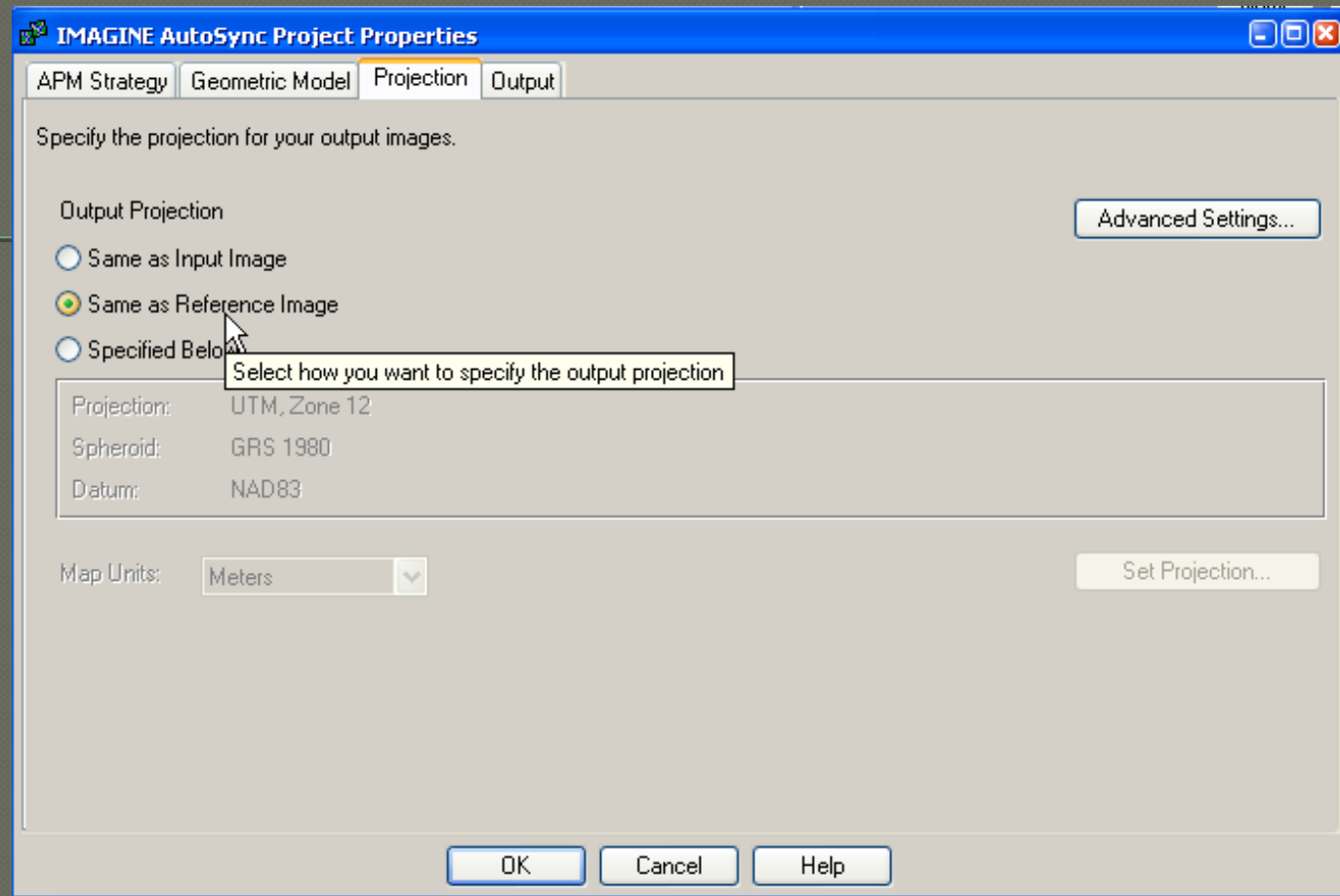
- Just about perfect!
- Now you can adjust the link boxes in the lower panes to about the same size, and use them to zoom in on the image:(look at the inside images on the top) Now we can collect some manual control points to tie the imagery.

5. Verify and/or adjust your project parameters

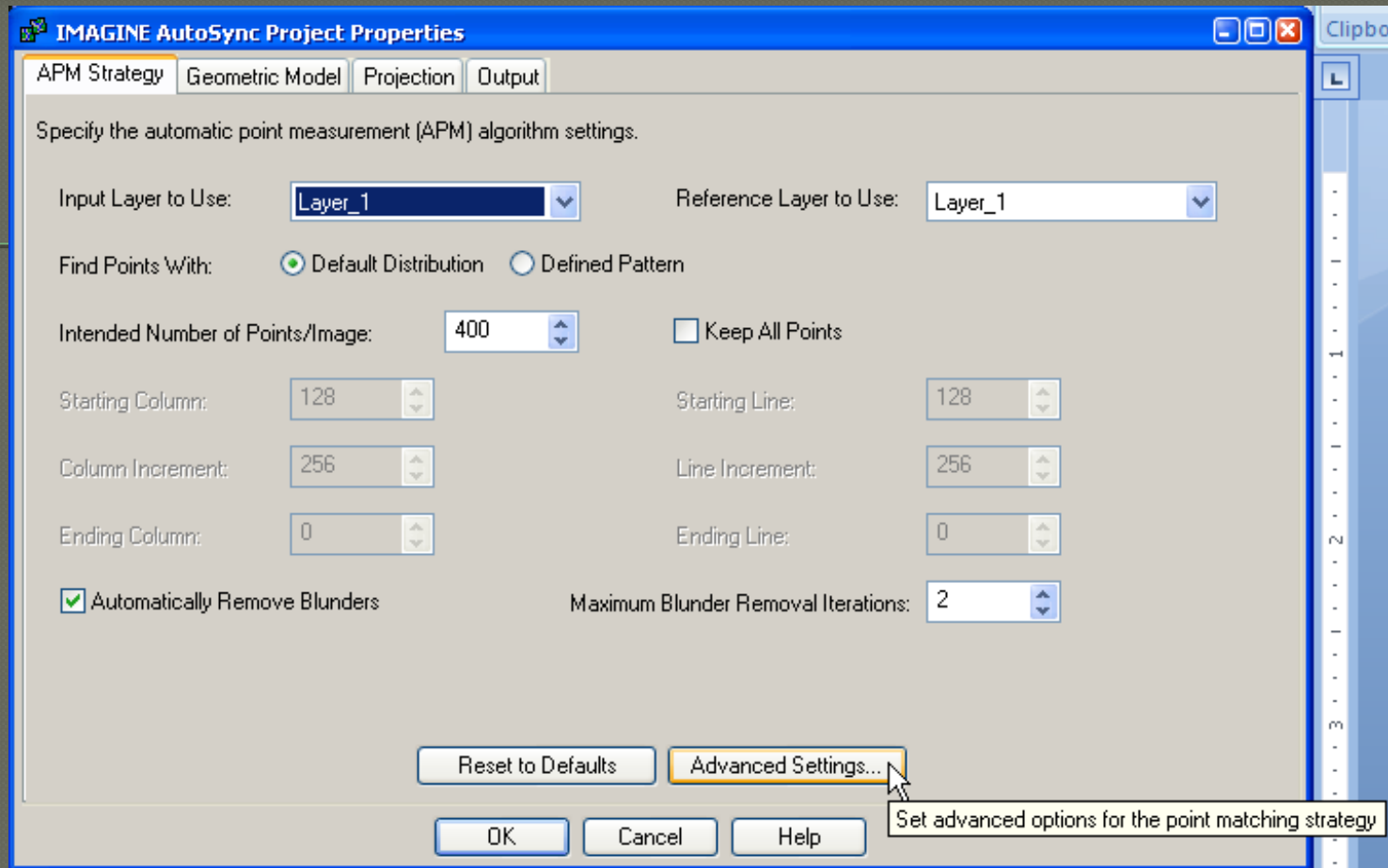
- ◉ Before solving your model or running automatic point matching (APM), you will need to set up your parameters
- ◉ Here you will define what strategy you want to use for APM, the geometric correction model, projection, and output settings.



- You can read more about modeling in that chapter in the AutoSync manual. For air photos the Direct Linear Transform is typically the best model to use.

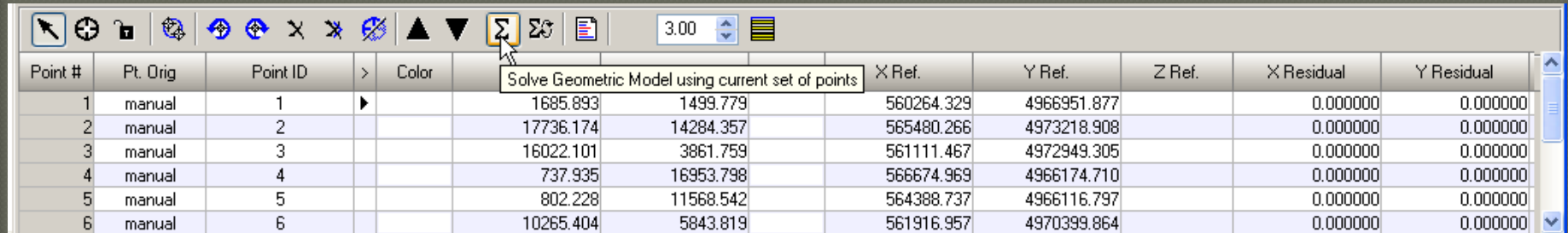


- Make sure the radio button for "Same as Reference Image" is selected
- On the "Output" tab, you can make changes to your output and resampling settings - these were defined when you created your project, so only change the settings if you need to.



- Last, click back on the first tab, the "APM Strategy" tab.
- This tab has a lot of settings, all affecting the generation of automated tie points. You should read the section in the pdf manual "APM Engine" if you have questions.
- Make sure you are matching the correct layer to the correct layer - if you have a 3 band image and a 4 band image, pick the bands that are spectrally closest to one another.

6. Solve model



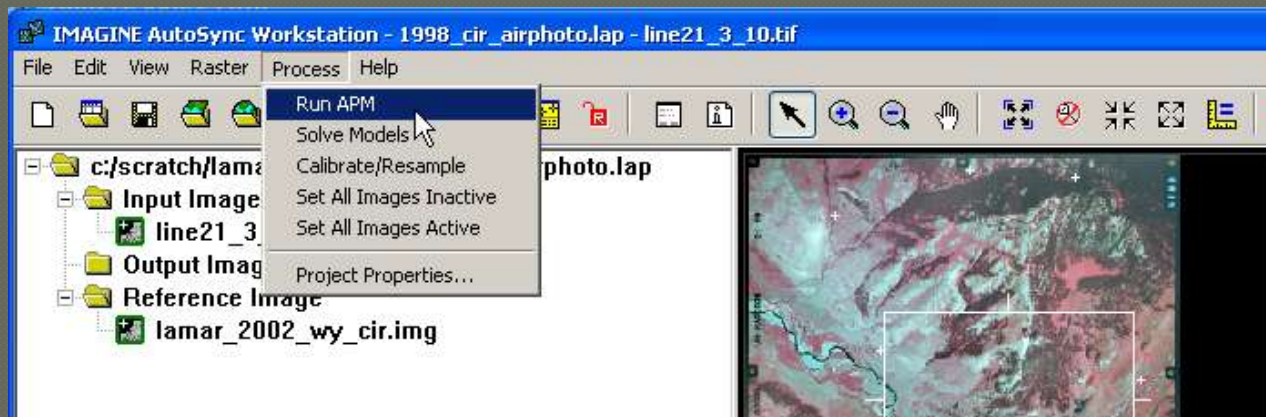
The screenshot shows a software interface with a toolbar at the top and a table below it. The toolbar contains various icons for navigation and editing. A mouse cursor is hovering over a button labeled "Solve Geometric Model using current set of points". The table below displays data for six points, including their origin, ID, color, and coordinates (X Ref., Y Ref., Z Ref.), along with their residuals (X Residual, Y Residual).

Point #	Pt. Orig	Point ID	>	Color		X Ref.	Y Ref.	Z Ref.	X Residual	Y Residual
1	manual	1	▶		1685.893	1499.779	560264.329	4966951.877	0.000000	0.000000
2	manual	2			17736.174	14284.357	565480.266	4973218.908	0.000000	0.000000
3	manual	3			16022.101	3861.759	561111.467	4972949.305	0.000000	0.000000
4	manual	4			737.935	16953.798	566674.969	4966174.710	0.000000	0.000000
5	manual	5			802.228	11568.542	564388.737	4966116.797	0.000000	0.000000
6	manual	6			10265.404	5843.819	561916.957	4970399.864	0.000000	0.000000

- Click on the solve button - this will generate the residuals and errors based on your manual tie points. If your RMSE is acceptable, go on to the next step. If not, go through your points and add, delete, or modify as needed.

7. Run automatic point matching (APM)

Let the fun begin!!!





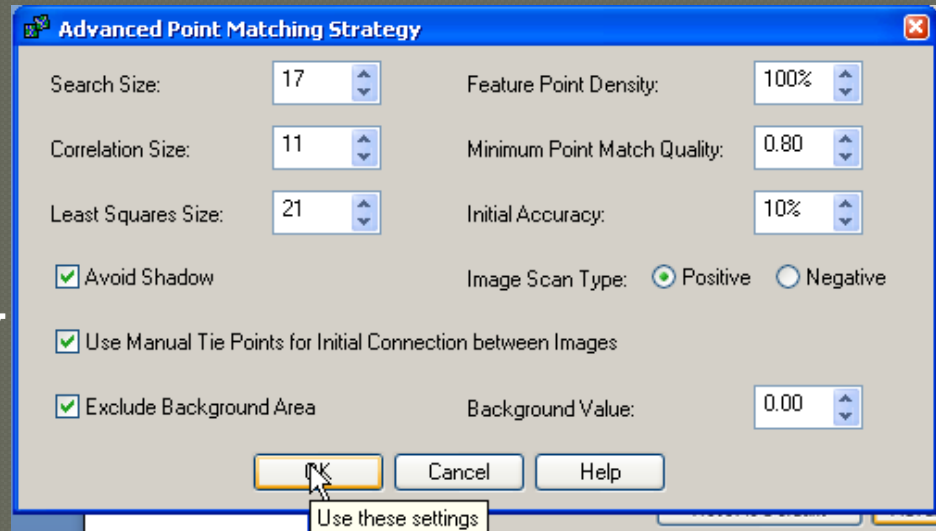
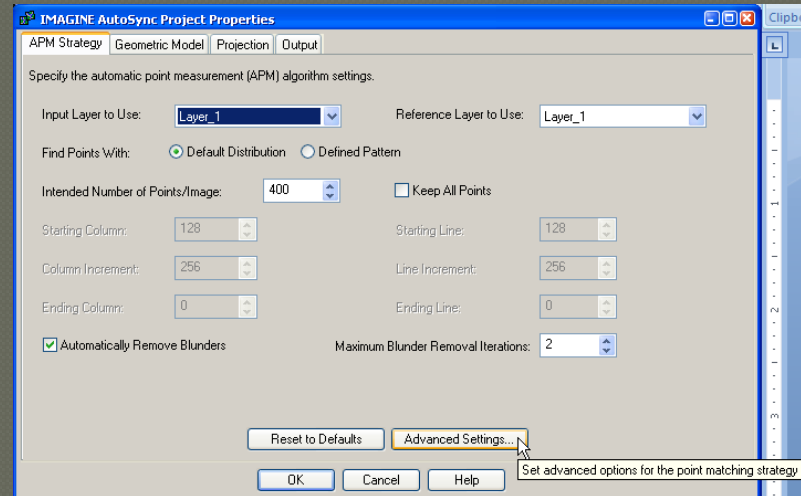
Point #	Pt. Orig	Point ID	>	Color	X Input	Y Input	Color	X Ref.	Y Ref.	Z Ref.	X Residual	Y Residual	Error	Contribution
1	manual	2			214.770	898.037		554687.705	4977480.103	1908.664	3.348767	10.987624	11.486606	0.005294
2	manual	3			7957.915	8899.671		568004.098	4963392.708	2277.592	1.045246	0.009233	1.045287	0.000044
3	manual	4			1675.974	8715.271		557612.828	4964045.473	2736.068	1.781060	-8.214284	8.405155	0.002835
4	manual	5			9862.007	1073.382		571394.779	4976578.549	2569.001	1.296197	-12.256647	12.324996	0.006096
5	manual	6			8888.520	9333.326		569499.298	4962716.543	2412.691	0.870031	-0.524887	1.016101	0.000041
6	manual	7			1872.545	9229.413		557885.019	4963161.162	2659.479	-2.308619	-4.552181	5.104123	0.001045
7	manual	8			1270.001	2939.332		556604.123	4973781.515	2012.665	-2.582546	-2.395382	3.522414	0.000498
8	manual	9			4851.624	5601.440		562822.627	4969028.652	2011.018	2.211216	-2.088820	3.041816	0.000371
9	manual	10			5313.624	5703.858		563614.566	4968838.980	2015.147	-1.882203	-1.320375	2.299147	0.000212
10	manual	11			5858.605	5524.440		564571.543	4969138.267	2064.747	3.799743	-0.610597	3.848490	0.000594
11	manual	12			6320.606	5735.256		565369.640	4968765.083	2035.697	5.623317	-3.021097	6.383472	0.001635
12	manual	13			6557.586	6294.440		565758.835	4967795.789	2045.685	4.503619	-4.264125	6.202044	0.001544
13	manual	14			6310.887	5549.858		565357.324	4969084.075	2056.895	6.399383	-1.067229	6.487764	0.001689
14	manual	15			4588.478	6748.217		562338.596	4967051.884	2028.854	0.910580	-2.920899	3.059544	0.000376
15	manual	16			5800.295	813.981		564574.007	4977125.393	2511.169	-0.294660	3.316453	3.329518	0.000445
16	manual	17			9956.054	5920.654		571232.203	4968425.152	2726.069	-2.894030	-2.952562	4.134372	0.000686
17	manual	18			4518.954	5056.459		562254.845	4969984.397	2020.685	-0.116974	-2.014135	2.017529	0.000163
18	manual	19			3886.507	5676.197		561145.146	4968915.342	2032.467	-0.109901	2.014895	2.017890	0.000163
19	manual	20			4050.226	4573.527		561451.822	4970831.759	2030.641	-0.330335	0.847902	0.909977	0.000033

RMSE: 8.06, Error Std. Dev.: 5.394 (Input) pixels

Output Projection: UTM

Oh &*\$@ \$!! What went wrong?

- You have horrible RMSE and none of your points match up - what do you do?
- Don't panic!
- Delete the auto-generated points
- Check and adjust your settings
- Try a different band
- Worst case: Start a new project with a different reference image



OK, I can live with this RMSE...

8. Verify and/or delete control points

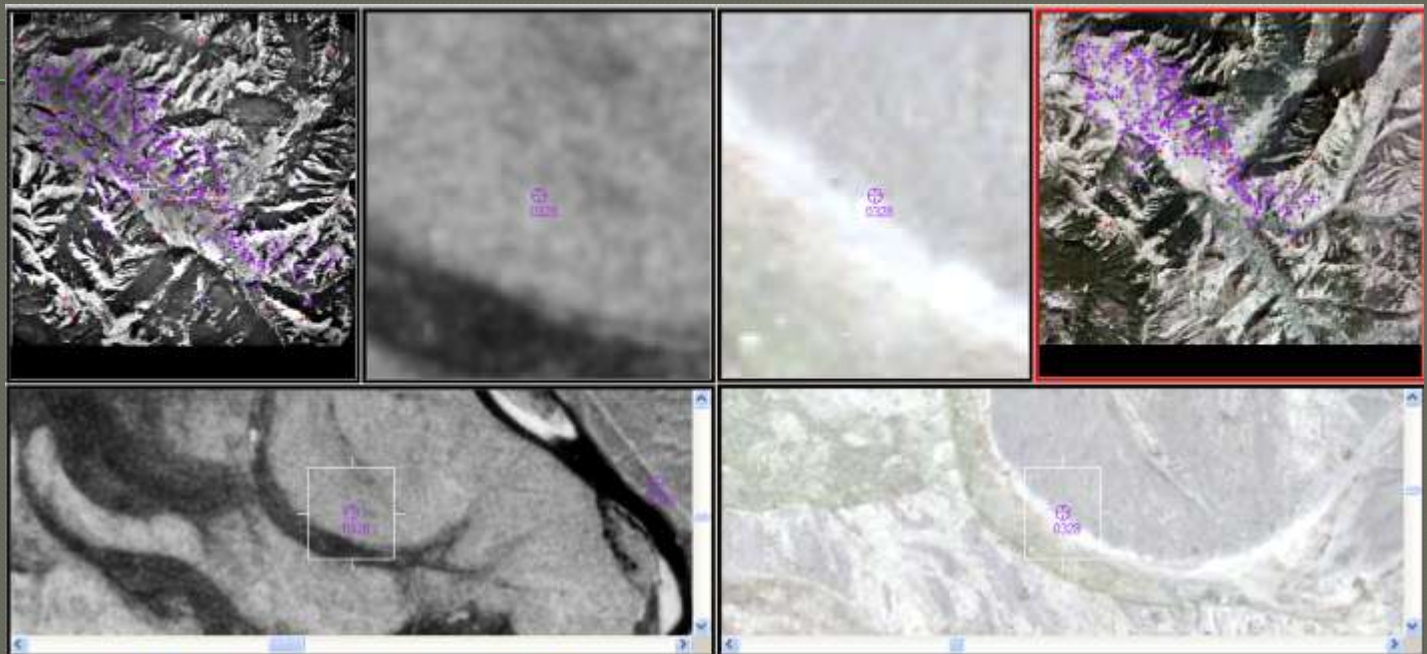
- There are a couple of ways you can go about checking the control points - deleting those over a certain error threshold or stepping through your points manually. I like a combination of both.
- Sort your points by error, highest first
- Now you can see what kind of error you are talking about - is it just a few outliers, or a bunch of bad matches? Usually this happens because of ground condition changes like fire, phenology, stream changes, landslides, etc.



The screenshot shows a software window with a table of control points. The table has columns for Point #, Pt. Orig, Point ID, Color, X Input, Y Input, Color, X Ref., Y Ref., Z Ref., X Residual, Y Residual, Error, Contribution, and Match. A context menu is open over the 'Error' column, showing options like Column Options, Select, Sort, Edit, Format..., Report..., Import..., Export..., Formula..., Color..., Alignment, and Compute Stats... The 'Sort' option is selected, and a sub-menu is open showing 'None', 'Sort A..Z', 'Sort Z..A', and 'Sort...'. The 'Sort Z..A' option is highlighted. The status bar at the bottom shows 'RMSE: 8.06, Error Std. Dev.: 5.394 (input) pixels' and a 'Cancel' button.

Point #	Pt. Orig	Point ID	Color	X Input	Y Input	Color	X Ref.	Y Ref.	Z Ref.	X Residual	Y Residual	Error	Contribution	Match
1	manual	2		214.770	898.037		554687.705	4977480.103	1908.664	3.348767	10.987624	11.4861	Column Options	0.000000
2	manual	3		7957.915	8899.671		568004.098	4963392.708	2277.592	1.045246	0.009233	1.0452	Select	0.000000
3	manual	4		1675.974	8715.271		557612.828	4964045.473	2736.068	1.781060	-8.214284	8.4051	Sort	0.000000
4	manual	5		9862.007	1073.382		571394.779	4976578.549	2569.001	1.296197	-12.256647	12.3241	Sort...	0.000000
5	manual	6		8888.520	9333.326		569499.298	4962716.543	2412.691	0.870031	-0.524887	1.0161	Edit	0.000000
6	manual	7		1872.545	9229.413		557885.019	4963161.162	2659.479	-2.308619	-4.552181	5.1041	Format...	0.000000
7	manual	8		1270.001	2939.332		556604.123	4973781.515	2012.665	-2.582546	-2.395382	3.5221	Report...	0.000000
8	manual	9		4851.624	5601.440		562822.627	4969028.652	2011.018	2.211216	-2.088820	3.0411	Import...	0.000000
9	manual	10		5313.624	5703.858		563614.566	4968838.980	2015.147	-1.882203	-1.320375	2.2991	Export...	0.000000
10	manual	11		5858.605	5524.440		564571.543	4969138.267	2064.747	3.799743	-0.610597	3.8481	Formula...	0.000000
11	manual	12		6320.606	5735.256		565369.640	4968765.083	2035.697	5.623317	-3.021097	6.3831	Color...	0.000000
12	manual	13		6557.586	6294.440		565758.835	4967795.789	2045.685	4.503619	-4.264125	6.2021	Alignment	0.000000
13	manual	14		6310.887	5549.858		565357.324	4969084.075	2056.895	6.399383	-1.067229	6.4871	Compute Stats...	0.000000
14	manual	15		4588.478	6748.217		562338.596	4967051.884	2028.854	0.910580	-2.920899	3.0591		0.000000
15	manual	16		5800.295	813.981		564574.007	4977125.393	2511.169	-0.294660	3.316453	3.329518		0.000445
16	manual	17		9956.054	5920.654		571232.203	4968425.152	2726.069	-2.894030	-2.952562	4.134372		0.000686
17	manual	18		4518.954	5056.459		562254.845	4969984.397	2020.685	-0.116974	-2.014135	2.017529		0.000163
18	manual	19		3886.507	5676.197		561145.146	4968915.342	2032.467	-0.109901	2.014895	2.017890		0.000163
19	manual	20		4050.226	4573.527		561451.822	4970831.759	2030.641	-0.330335	0.847902	0.909977		0.000033

- In this example, there are some definite errors. I would step through the points until I started getting into "good" points, then delete those points with a greater error. Then re-solve the model.



- Rinse
- Repeat

- Alternately, you could step through each point and visually check it. This depends on your time constraints.

Point #	Pt. Orig	Joint #	Color	X Input	Y Input	Color	X Ref	Y Ref	Z Ref	X Residual	Y Residual	Contribution	Match
205	APM	0359		8774.119	5298.594		569448.237	4969411.825	2340.933	-21.050992	30.725270	37.244952	0.055664
309	APM	0512		5905.662	8672.823		564600.453	4963838.115	2309.908	33.334803	-3.438943	33.511721	0.045065
264	APM	0326		4183.614	5276.354		561620.880	4960933.961	1986.901	-30.632495	1.794386	30.695006	0.037783
232	APM	0282		6890.114	4490.996		566294.836	4970931.430	2270.911	-27.958758	3.549613	27.786416	0.030982
82	APM	0082		4715.903	2183.862		562710.926	4974805.797	2652.656	-6.823005	-26.932436	27.783259	0.030975
20	APM	0008		1230.042	1280.102		556850.261	4976631.971	2254.278	-17.981123	-20.347677	27.154166	0.029588
328	APM	0442		9180.075	6874.869		570035.656	4966794.686	2508.901	3.213056	26.073756	26.270985	0.027696
315	APM	0420		6186.742	6935.764		565127.133	4968668.996	2044.223	20.801818	12.438721	24.051540	0.023232
53	APM	0052		3575.875	1926.819		560796.300	4975294.487	2424.593	15.623000	16.613871	22.805813	0.020870
23	APM	0014		1100.413	1628.014		556400.354	4976095.087	2192.835	-11.289112	-19.491305	22.524543	0.020298
347	APM	0472		9027.374	7318.249		559855.539	4966023.082	2352.208	14.212566	17.059526	22.204154	0.019784
55	APM	0054		560.701	2495.260		555421.466	4974539.956	2060.455	16.797452	14.275653	22.044243	0.019600
363	APM	0494		8022.229	7589.401		568174.835	4965605.885	2190.221	-6.192723	-21.065152	21.956558	0.019345
293	APM	0372		5234.947	5778.611		563441.614	4968771.444	2007.196	-21.709392	-2.739739	21.881587	0.019213
378	APM	0511		8714.061	8187.780		569327.068	4964522.526	2135.550	-21.199506	-2.933778	21.401545	0.018379
52	APM	0051		3422.232	2119.671		560515.492	4975012.577	2471.410	-1.381838	-20.731311	20.777313	0.017323
362	APM	0481		6557.632	7444.091		565688.139	4965788.532	2060.413	-14.968912	14.199462	20.343990	0.016608
329	APM	0444		2042.616	7147.527		558143.888	4966549.207	2600.560	-17.610164	1.036093	17.640617	0.012487
255	APM	0312		7190.817	5054.949		566853.410	4969902.522	2037.185	-13.778136	9.906814	16.970033	0.011556

9. Re-solve model

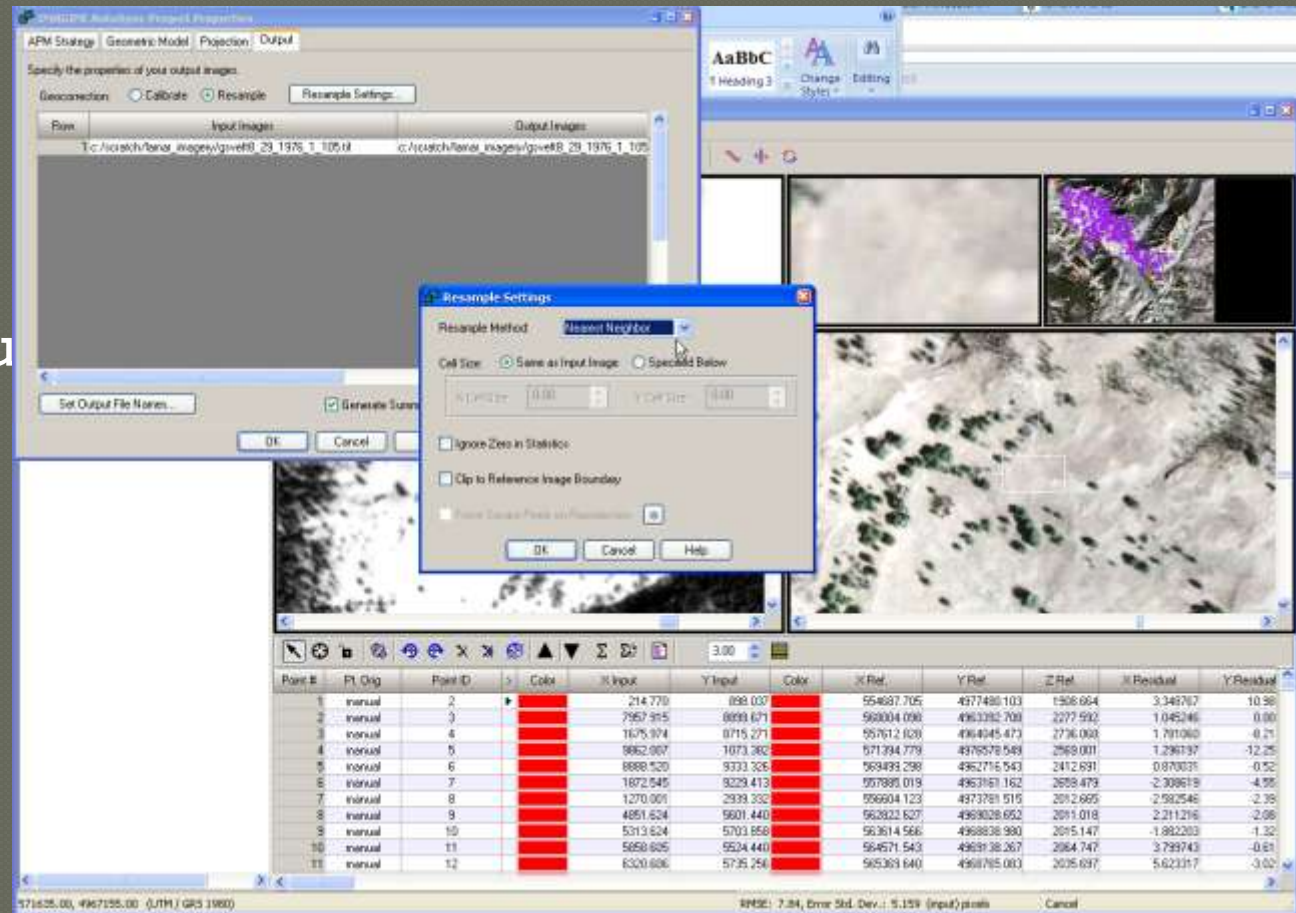
Point #	Pt. Orig	Point ID	>	Color	X	Y	Z	X Ref.	Y Ref.	Z Ref.	X Residual	Y Residual
1	manual	2	▶		214.770	898.037		554687.705	4977480.103	1908.664	3.348767	10.98
2	manual	3			7957.915	8899.671		568004.098	4963392.708	2277.592	1.045246	0.00
3	manual	4			1675.974	8715.271		557612.828	4964045.473	2736.068	1.781060	-8.21
4	manual	5			9862.007	1073.382		571394.779	4976578.549	2569.001	1.296197	-12.25
5	manual	6			8888.520	9333.326		569499.298	4962716.543	2412.691	0.870031	-0.52
6	manual	7			1872.545	9229.413		557885.019	4963161.162	2659.479	-2.308619	-4.55
7	manual	8			1270.001	2939.332		556604.123	4973781.515	2012.665	-2.582546	-2.39
8	manual	9			4851.624	5601.440		562822.627	4969028.652	2011.018	2.211216	-2.08
9	manual	10			5313.624	5703.858		563614.566	4968838.980	2015.147	-1.882203	-1.32
10	manual	11			5858.605	5524.440		564571.543	4969138.267	2064.747	3.799743	-0.61
11	manual	12			6320.606	5735.256		565369.640	4968765.083	2035.697	5.623317	-3.02

RMSE: 7.84, Error Std. Dev.: 5.159 (input) pixels

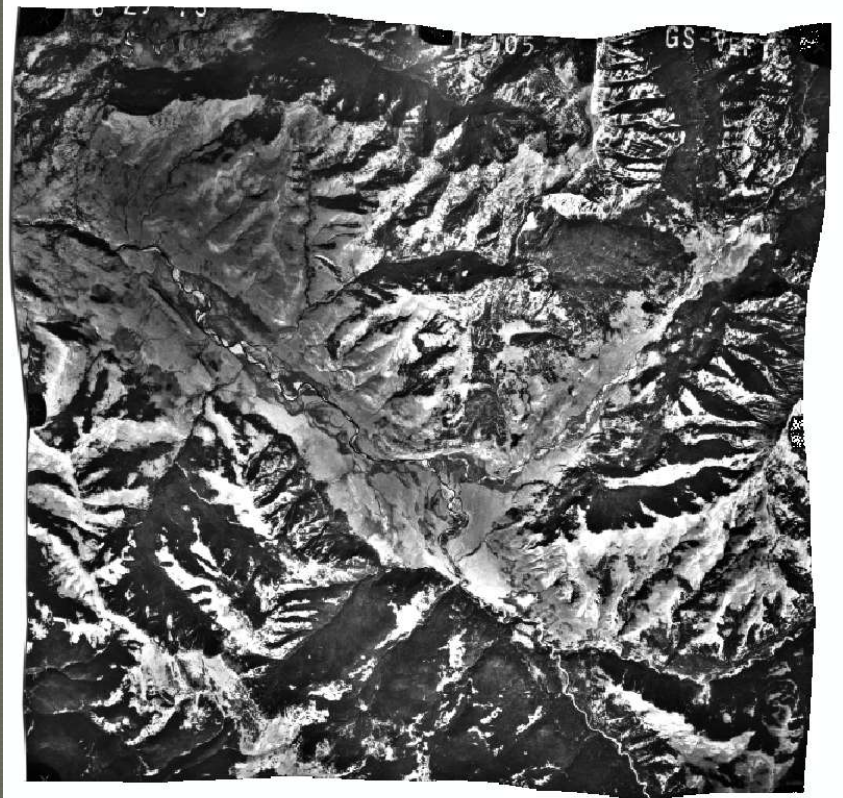
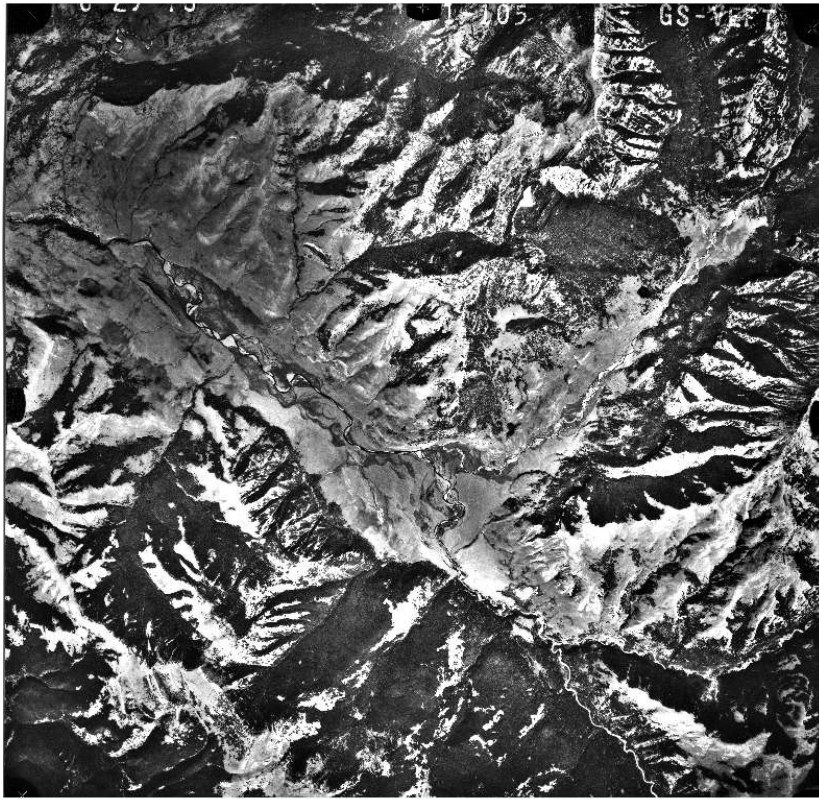
Cancel

10. Resample Image (create output image)

- It's a good idea to verify your project parameters again - On the "Output" tab, you can make changes to your output and resampling settings - these were defined when you created your project, so only change the settings if you need to.



Presto!



More Magic...

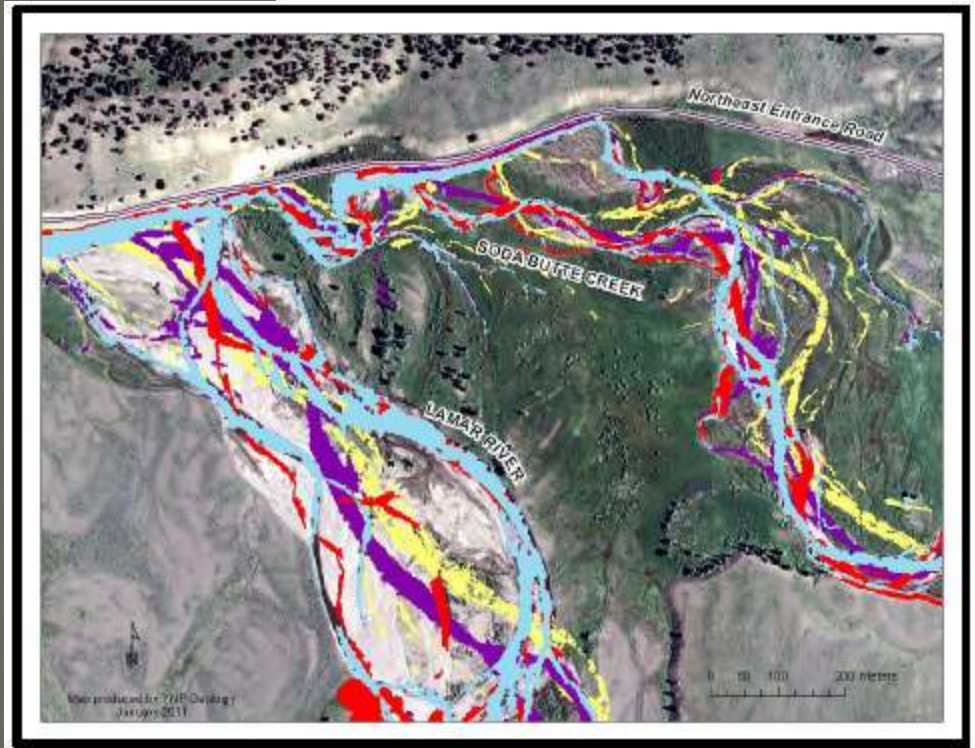
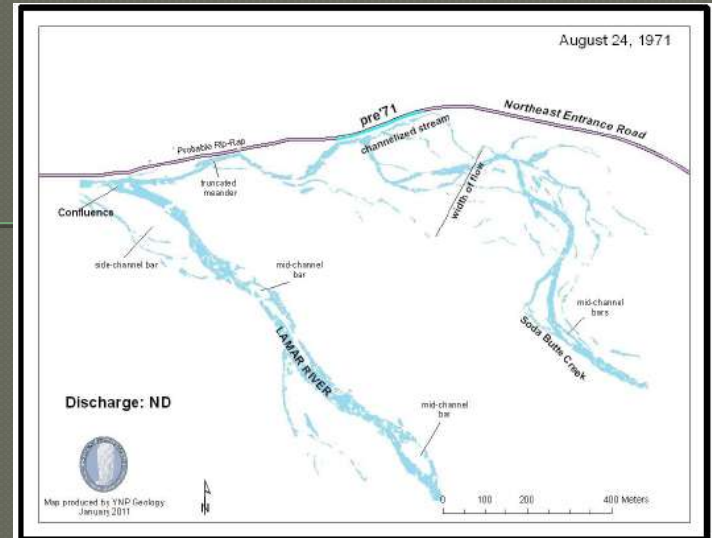
THE EFFECT OF RIP-RAP ALONG SODA BUTTE CREEK NEAR THE CONFLUENCE OF THE LAMAR RIVER AND AT ROUND PRAIRIE



Figure 1. Photograph of the Lamar River drainage showing grassy river terraces and snow-covered Absaroka Mountains.

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Questions?

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